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PREDICTORS OF ACADEMIC SUCCESS OF GRADUATE STUDENTS IN THE COMMUNICATIONS MANAGEMENT CURRICULUM OF THE U. S. NAVAL POSTGRADUATE SCHOOL

Jon Leslie Cook

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THESIS

PREDICTORS OF ACADEMIC SUCCESS OF GRADUATE STUDENTS IN THE COMMUNICATIONS MANAGEMENT CURRICULUM OF THE U. S. NAVAL POSTGRADUATE SCHOOL

by

Jon Leslie Cook

September 1974

Thesis Advisor: R. A. Weitzman

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Results showed that a method of predicting academic performance, using information currently available to the Postgraduate

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The variables selected for predicting academic success were: third and fourth year undergraduate grade-point averages, undergraduate major in engineering (yes or no), and graduate of the U. S. Naval Academy (yes or no). Tables are presented to facilitate the use of the method developed.

The report also summarizes the relationship to two criteria, academic performance and satisfaction, of all the instruments and information used and recommends the direction of future research.

Predictors of Academic Success of Graduate Students in the Communications Management Curriculum of the U. S. Naval Postgraduate School

by

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Lieutenant, United States Navy
B.S., United States Naval Academy, 1967

Submitted in partial fulfillment of the
requirements for the degree of

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I. INTRODUCTION

A. GENERAL

The rapidly changing science and technology of today's Navy have created a large and increasing need for officers with postgraduate education.

The Secretary of the Navy stated his policies on graduate education for naval officers in his instruction of 2 July 1971:

> The characteristics of our Navy and Marine Corps of today and especially of the future, demand that we keep under continuous evaluation the educational base of our officers. The rapid advance of knowledge is being, and will continue to be, manifested in the Naval Service in ships, systems, equipment and, most importantly, our people to a degree equal to that of any other field of endeavor.
>
> In order to exploit the full potential of this advance in knowledge, the graduate education programs must prepare officers of the line, restricted line and staff corps, to meet requirements in a wide variety of technical, managerial and policy making assignments. Graduate level education in specific discipline is often essential for optimum performance of duty.
>
> Previous concepts of the types and extent of academic knowledge required to establish the requisite educational base must be revised to any extent necessary to meet this modern challenge. [1]

The Operational Technical Managerial System (OTMS) has been established by the Chief of Naval Personnel to provide officer-professional-development management in all areas of Navy endeavor. The system includes the subspecialist programs, with a primary goal of insuring that officers are properly coded in order to provide the correct assets to fill the subspecialty billets.

A subspecialty is a classification category defined by an operational, technical, or managerial field of interest to the Navy, which requires specialized professional skills or knowledge.

"In those cases where curricula, peculiar to the Navy, are necessary (e.g., Naval Communications, Aeronautical Engineering, Ship Engineering, etc.), criteria for coding must be expressed to reflect the need for that additional education.

To keep subspecialty billets filled on a continuing basis, the number of qualified officers must exceed the number of billets."[2]

B. POSTGRADUATE SELECTION PROCESS

Based on billet requirements, which are forecast by CNO, and the anticipated manpower resources, the Chief of Naval Personnel calculates an officer postgraduate education quota for each subspecialty.

These quotas are transmitted annually to the Postgraduate Selection Board, which selects those officers who are eligible to attend postgraduate school in support of the basic policy as previously expressed by the Secretary of the Navy.

The Postgraduate Selection Board screens all eligible officers and takes into consideration the stated preferences of the individual officer, as well as his professional performance and academic background records. The 1975 Fiscal Year (FY 75) Board considered 15,406 officers and selected only 1,285, or 8.3%.[3]

In selection, a brief sheet filled out for each officer considered contains two major variables: Educational Potential Code (EPC) and professional performance.

An Education Potential Code (EPC) is computed for each officer by considering previous courses taken in college, the grades received in each course, and his overall grade point average. A major problem is that all colleges and universities do not use the same grading system: each institution varies as to the criteria for grades, and all institutions are not equal as to course depth and scope or difficulty.

An overall professional performance code is established from fitness reports.

The EPC and performance code are assigned different weights, and the selection process begins utilizing quotas assigned from the Chief of Naval Personnel.

The Communications Management curriculum board considered 411 officers in FY 74 and selected 54, or 13.6%. In FY 75, they considered 1,146 and selected 202, or 17.6%.[3]

Within the past three years in the Communications Management curriculum, two officers have dropped from the course of instruction at the Naval Postgraduate School, and five officers received a "Certificate of Completion" rather than a Masters degree.

In the light of Congressional pressure to reduce military-funded officer education, as well as the severe budget constraints, we can least afford mistakes or false starts of any

nature. Any method which will improve the selection process for postgraduate education must be seriously considered.

C. PURPOSE OF THE STUDY

The purpose of this study is to investigate methods and criteria which could be effectively utilized by the Postgraduate Selection Board for classifying and selecting Navy officers for the Communications Management curriculum at the Naval Postgraduate School, Monterey, California.

If these methods and criteria are to replace the ones currently used to compute the Educational Potential Code and to assist officers submitting postgraduate school preferences, they should provide a realistic basis for evaluating potential for success in the Communications Management curriculum.

D. LIMITATIONS

This study was limited to male, U.S. Navy officers who were enrolled in the Communications Management curriculum. The population size is 42.

E. DEFINITIONS

The following definitions are enumerated as they are used throughout the study to avoid misinterpretations.

1. Quality Point Rating (QPR) - a student's weighted grade score computed from standards established by the Naval Postgraduate School as follows:

GRADE	QUALITY POINT NUMBER
A	4.0
A-	3.7
B+	3.3
B	3.0
B-	2.7
C+	2.3
C	2.0
C-	1.7
D+	1.3
D	1.0
X	0

Multiplying the term credit hour value of a course by the quality point number received provides the total quality points for that course. Adding the quality points for all courses and dividing by the total number of credit hours result in a figure defined as the quality point rating (QPR).

2. Graduate Record Examination (GRE) - this test is prepared by Educational Testing Service of Princeton, New Jersey, and is widely used throughout the United States by graduate institutions to determine student aptitude for graduate level study. The GRE is a secure test which is administered under controlled conditions.

The GRE (aptitude) requires a total working time of three (3) hours and yields two scores: verbal ability (GREV) and quantitative ability (GREQ). Included in the test are verbal reasoning and reading comprehension questions, and various mathematical problems involving arithmetic reasoning, algebra, and the interpretation of graphs, diagrams, and descriptive data. Scores range between 200-800 with a mean of 500 and standard deviation of 100.

3. Biographical Questionnaire - the questionnaire was developed by Professor R. A. Weitzman with assistance from this author. It was designed to obtain historical/biographical facts and certain opinions concerning attitudes towards postgraduate education and its place in today's Navy.

The historical/biographical facts are reliable over time and administratively verifiable. The opinions were solicited to discover if there were any personal ideals, attitudes, or motives possibly satisfied by graduate education that would aid in predicting academic success.

The questionnaire utilized a booklet with 61 questions which required "yes" or "no" responses. The answers were recorded on a separate sheet that was read by an optical scan machine. The answer sheet also contains an administrative section which required information as to: social security number (for identification), undergraduate institution previously attended, current curriculum, number of quarters completed in current curriculum and QPR.

4. Stepwise Pattern Analysis (PA) - a technique in which a small number of items are selected from a larger number for their ability to predict criterion performance. Each pattern of responses to the selected items is assigned a score, called a pattern score, that is equal to the mean score on the criterion of all individuals who have the pattern in a validation group. The selection of items depends not on the correlation of responses to individual items but on the correlation of pattern scores with criterion performance.

The Naval Postgraduate School Master's Thesis of B. F. Folce, Jr., describes the technique in detail.

5. Strong Vocational Interest Blank (SVIB) - this test is prepared by the Stanford University Press of Stanford, California and is widely used throughout the United States to measure individual interests as related to interests of incumbents in various occupations.

The SVIB requires a working time of approximately one hour and contains 399 items. Items consist of listings of occupations, hobbies, school subjects, kinds of people, and other matters to which examinees react by expressing likes, dislikes, or indifference. In scoring, examinee responses are compared with responses of persons who have achieved success in various occupations.

6. Reliability - is an indicator of the consistency or stability of test results. It is reported as a correlation coefficient that expresses the degree to which individuals keep the same relative standing in a group when two equivalent forms of a test are administered to all members of the group. Values range from 0 to 1.0.

7. Validity - is an indicator as to the degree a test measures what it is intended to measure. Values range from 0 meaning there is no relationship to +1 meaning a perfect positive correlation.

8. Grade-point Average - (GPA) a student's weighted grade score computed from standards previously established in the definition of QPR for undergraduate work.

II. BACKGROUND

A. GENERAL

General and research interest in the variability of procedures used in the selection of students for graduate institutions is appropriate for at least three reasons: one, intrinsic interest in the predictability of behavior and the predictive power of behavioral measures; two, demands of national and education - institution economics; three, the maintenance of the highest standards possible for educational process and institutions.

Interest in predicting success in graduate school has increased in the past several decades. The number of applicants for graduate education has dramatically increased; for example, within the U. S. Navy the number of officers who have requested consideration for postgraduate education has increased from 11,873 in 1972 [4] to 15,406 in 1973 [3]. Similar increases have developed at admission offices of other graduate institutions.

As the number of applicants for graduate education has increased throughout the United States, graduate schools have applied more stringent criteria to select those applicants with a high potential for successfully completing graduate studies. As the demand for higher education increases, questions are bound to be asked that have profound bearing on the usefulness of methods of selection.

There are numerous measures that have been used as predictors of success in graduate school. Examples include one, undergraduate GPA, which is relevant as it represents the same sort of variable one is trying to forecast, but its weakness is that colleges differ with regards to both the quality of education they provide and the degree of academic competition faced by their students; two, references from undergraduate professors--although relevant they are generally not quantifiable or objective, and they are administratively impractical to handle; three, background information and consideration of special accomplishments or experience of applicants--these can be pertinent but are too often difficult to quantify; four, nationally administered standardized tests which provide a common measure for comparing the qualification of applicants.

Many of the above factors and others such as interests, motivation, and determination must enter into the process of predicting success of applicants for graduate study.

B. BIOGRAPHICAL INFORMATION

The use of self-reporting biographical questionnaires has been very limited in selection procedures for educational institutions. Two basic reasons have limited usage: one, there has not been extensive research in the area of biographical questionnaires as useful predictors in the academic environment; two, if some particular characteristic of applicants does demonstrate an ability to differentiate success in graduate education, it may be difficult to justify using

such findings in selecting students for admission because of the nature of the characteristic.

For example, there have been several psychological theories put forth in the area of birth-order effects and eminence in achievement and academic success.

Later-borns out number first-borns by approximately two to one in the population of the United States. Yet of twenty-three astronauts who had traveled in space by the end of 1972, twenty-one are either only children or first-born.

Altus [5] found in a study conducted at the University of California at Santa Barbara that over sixty percent of all entering students were first or only-born children. Clifford [6] indicated a significant over-population of first-borns in the college population for both Anglos and Spanish families.

Mothers generally give more complex technical explanations to first-borns, exhibit greater pressure for achievement, and greater anxious intrusiveness into the performance of the first-born, according to Rothbart [7]. With the arrival of another child, the first-born experiences a drop-off in affection and attention which later children do not suffer. The older child cannot compete with a younger one in behavior which brings attention or cuddling as well as he can compete, by virtue of his maturity, in intellectual or physical skill, which can elicit esteem or attention, Lasko [8].

Schacter [9] summarized a variety of studies linking birth-order and achievement by saying that first-borns predominate with astonishing consistency. They are over-represented in "Who's Who."

However, the apparent superiority of first and only-borns in achieving academic and professional eminence stands in marked contrast to the evidence concerning performance under stress. Schacter found that first and only-borns were inferior in performance when judged on the criterion of the number of Migs shot down during the Korean War: later-borns were more likely to achieve "Ace" rankings as pilots.

Helmreich and Radolff [10] discovered that the performance of later-borns was significantly better than that of first and only-borns as divers in Project Sealab.

Though a doubt exists regarding the relationship between birth-order and other variables, the fact remains first and only-borns pre-eminate in academic achievement.

Clifford [6], in a study of 61 Mexican-American University of Arizona freshmen discovered that the ALPHA Biographical Inventory, in which the individual describes himself and his background through 300 multiple-choice items, was indeed an excellent predictor of college grade-point average. The items include a wide variety of questions about childhood activities, experiences, sources of derived satisfaction and dissatisfaction, academic experiences, attitudes and interests. Clifford concluded "the biographical approach is a powerful predictor of academic achievement. It has added significantly to the prediction of whatever criterion was of interest in

the literature, and it has done so in this study. The mere fact that the validity coefficient (.62) of one scale of the ALPHA (ALPHA GPA) is better than the multiple R obtained for the presently used predictors (high school grade-point average and ACT score, equal to .60) is indicative of this power."

Fudge [11] determined, in a study of 35 percent of the 1963 freshmen students at the University of Texas, that biographical data could be effectively used to predict academic performance. Biographical information plus the SAT test scores and academic performance measures (GPA) were used. It was found that biographical information greatly aided in the accurate prediction of criteria of academic performance in college. It aided to the extent that biographical information together with aptitude test scores better estimate academic performance than the commonly used predictive index of high school GPA and aptitude tests.

Szabo [12] investigated the relationship of biographical variables and GPA in a biological science course of Purdue University upperclassmen (N = 630). He also used SAT scores, high school grades and class standing. He concluded that SAT mathematics and science scores plus high school grades were the best intellective predictors of final course grade. However, specific biographical items were significant predictors of the final course grade in their own right and the use of certain personality and biographical predictors showed promise for increasing predictive efficiency.

Autobiographical information in conjunction with previous educational background, GPA, and personality and motivational characteristics were used by Hamilton and Freeman [13] in a study of 169 British University Students. They concluded that the more homogeneous the group from which you are to select prospective candidates the more valuable non-scholastic or non-cognitive factors become. Autobiographical information made useful contributions to the multiple correlations and regression equations.

Wilson [14], in a study of prediction of academic success of graduate students at the Air Force Institute of Technology (AFIT) (N = 154), indicated that certain biographical items were useful as predictors of academic success. Some of the useful predictors were age, source of commission, and type of commission (branch of restricted line versus unrestricted line).

In 1965, Watson found in a study of 84 college students that the father's educational level correlated .32 with GPA at the .05 significance level [15].

C. STRONG VOCATIONAL INTEREST BLANK

Traditionally, the GRE in some combination with undergraduate GPA has been the method used by most graduate schools as a selection measure of applicants. However, those placed in the position of selecting applicants have often asked for information on, or some method to measure student motivation, interest, and personal history. "There have been many pertinent studies at the undergraduate level, and

Freeberg documents a number of instances where such student self-reporting devices have made small but significant contributions to predict grades." [16]

The SVIB test results come from over 100,000 diverse adults in over 400 occupations over 40 years. The vast majority have been employed for at least three years, are successful in their jobs, and say they like their work [17].

As an example, the Army Officer Scale of the SVIB was developed from 463 Army field grade officers, all West Point graduates with an average of 18 years experience in the military, who had all been rated above-average on Army Officer Efficiency ratings [17].

Men in different jobs have different interests. The SVIB is a device to identify such differences among those occupations that college students usually enter. The SVIB accomplishes this by providing an index of the similarity between a person's interests and those of successful men or women in each of a wide range of occupations. Interest ratings are generally better indices of job persistence than of job success [17].

The mean score for a particular occupation scale has been set at 50 with a standard deviation of 10. Thus, for example, engineers average 50 on the engineer's scale.

An individual's occupational profile tends to change very little between the ages of 20 and 25 and thus it is well suited for testing adults.

People sometimes give different answers when they are applying for a job or advanced training than when they are seeking counseling, but the differences are mild, usually about 3 or 4 point on an individual occupational score [17].

There are several non-occupational scales, which have been developed with a specific purpose in mind. Some of these scales are as follows: Academic Achievement Scale (AACH), created to identify patterns of interest associated with good scholarship; Managerial Orientation Scale (MO), developed by Nash (1966) to identify patterns of interests associated with managerial effectiveness; Masculinity-Femininity Scale (MFII), developed by Strong (1943) to separate those interests which are associated with men in general or women in general; Introversion-Extroversion Scale (OIE), which indicates the "Things versus people" dichotomy; Occupation Level Scale (OL) which differentiates people who like manual labor from those who prefer white-collar-type jobs; Specialization Level Scale (SL), "which may be interpretated as measuring a desire or willingness to narrow one's interests to become a specialist in an occupational field through advanced study" [17]; NROTC-Retention Scale, developed by Abrahams and Neumann (1970) to differentiate between Naval officers who remain for a career versus those who resign and pursue other careers.

Fernald, Law, and Bennett [18], in an unpublished study at the Naval Postgraduate School (N = 903) indicated high QPR students had interests on the SVIB similar to computer

programmers, chemists, psychologists, physicists, biologists, mathematicians and engineers. "This indicates that students having similar interests to the physical science occupations can be expected to attain high QPR's at the Naval Postgraduate School."

Campbell [17] obtained a correlation of .52 for the AACH and GPA of 462 freshmen at the University of Minnesota. In 1966, he evaluated 250 male students from the University of Minnesota and found a correlation of .36 between the AACH and GPA [19].

Wagman [20], in a study of 193 undergraduate and graduate students at the University of Illinois, obtained a correlation coefficient of .35 for the AACH and GPA, which was significant at the .01 level.

However, in two other studies the AACH scale was found to have little, if any, relationship to GPA. Lindsay and Althouse [21], using Pennsylvania State University freshmen, (N = 388) concluded the AACH scale provided only very limited utility in predicting first year college achievement. Frank [22], in a study of 200 University men came to the same conclusion--there was no significant relationship between the AACH scale and GPA.

Melville and Fredriksen [23] investigated the relationship between measures of first year academic achievement and scores on the SVIB for a group of freshmen engineering students at Princeton University. They found that correlations between freshmen average grade and Strong scales,

which were significant at the .05 level, indicated that academic achievement in the engineering curriculum was most closely related in a positive manner for psychologists (.32), chemists (.26), mathematics-physical science teachers (.24), mathematicians (.22) and physicists (.20). They concluded that it appeared the use of the SVIB in advising students regarding probable academic success in the engineering curriculum was justified to a limited extent in that academic success for their group was directly related to interests in activities associated with men in scientific occupations.

Abrahms and Neuman [24] have utilized the SVIB on several different occasions and constructed scales from the 399 items on the SVIB as predictions of various traits or behavior. In a study of Midshipmen at the U. S. Naval Academy, 1973, they derived an empirical key of 10 items which differentiated Midshipmen who had become academic drop-outs from other Naval Academy students, with a correlation of .55 (N = 92). Another scale was developed--the motivational disenrollment scale, which correlated .72 with motivation attrition.

Abrahms and Neuman [25] studied the use of the SVIB for predicting retention of officers in the National Oceanic and Atmospheric Administration (NOAA) and concluded: "A number of the standard SVIB occupational interest scales successfully discriminate between high and low tenure NOAA Officers, indicating that these two groups differ in their career interests. Further analysis, resulting in the construction and cross-validation of a highly predictive empirical scale, presents

additional favorable evidence for the potential use of the SVIB as a selection instrument."

Dore [26] utilized the SVIB to predict job satisfaction of 140 managers from the Unigard Insurance Company. He concluded the M.O. scale score of the SVIB was significantly related to job satisfaction as a manager.

D. THE GRADUATE RECORD EXAMINATION

The GRE has increased in utilization as a selection tool as witnessed by the increase in the number of candidates tested from 22,000 in 1958 to over 300,000 in 1973 [27]. This increased usage seems to have come about because of the following:

1. The GRE has been available since 1937 and is a well-refined test.
2. The GRE has maintained a reliability coefficient of .9 or higher (GRE APTITUDE). [27]
3. Total scaled scores are directly comparable across years (a score of 750 in 1968 is equivalent to a score of 750 scored on the same test in 1973).
4. It is a secure test, nationally administered at a reasonable cost of ten dollars.

A previous study of the validity of the GRE in predicting academic performance at the U. S. Naval Postgraduate School was conducted by Dreese and Russell [28] in 1964. Results indicated the GRE (APTITUDE) provided a validity of over .45 for QPR (N = 99).

Mehrabian [29] obtained a relationship between GRE and overall graduate school performance of .43 (N = 79) for graduate students in the UCLA department of psychology.

Houston and Strohmeyer [30] discovered validity coefficients between GRE verbal and QPR of .32 and GRE quantitative and QPR of .21 (N = 231), both significant at the .01 level, for students in various doctorial programs at Colorado State College.

Lannholm, Marco, and Schrader [31] conducted an extensive study of ten graduate institutions containing twenty-two departments (total N = 1009) with N varying from 26 to 116 in the departments. The study sought to evaluate the effectiveness of scores on the GRE and other factors in predicting success in graduate study. Each department was treated as a separate entity and validity coefficients of GRE with QPR ranged from a high of .47 to a low of -.28 with a mean of .14.

Lannholm [32] presented a summary of fourteen validity studies, from various graduate institutions, of the GRE as a predictor of success in graduate school. He observed the results varied considerably from one institution to another and among the subject fields involved.

"In most cases, both the undergraduate record and the test scores are positively related to performance in graduate study. Use of these variables in combination usually results in more effective prediction than either used alone.

The use of some rating of the quality of the applicant's undergraduate institution seems sufficiently promising to suggest its use in more research studies."

No one predictor is adequate by itself. However, taking a "weighted composite including undergraduate GPA and one or more of the GRE scores typically provides a validity coefficient in the .40 - .45 range for various criteria of success and for different academic fields."[27]

From a predictive viewpoint the validity correlations of GRE and QPR, at times, appear to be low but a trend is present. Large variations from one institution to another and even departments within the same institution suggest that reliance on GRE scores alone is questionable. When other items, such as undergraduate GPA are included with GRE scores, the validity increases. However, each institution should carefully evaluate measures to be utilized in selecting prospective graduate students as there appears to be no universal measure which will do a good job of predicting for all graduate schools. "It is important to undertake local studies in order to justify selection procedures and utilize available information to maximum benefit."[16]

E. SUMMARY

A review of the literature indicates that the GRE is often a significant predictor of academic success in graduate level study. When combined with undergraduate grades and some measure of effectiveness of the undergraduate institution, the predictive capability is usually improved.

A quantifiable method to measure non-intellectual interests, motivation, and background information appears to be worthy of further investigation to make a more comprehensive analysis of an individual's potential for success in graduate school.

To this end the SVIB and a biographical questionnaire were used in this study, together with the GRE, to obtain information on interests, motivation and background history as key items that differentiate individuals one from another. There has been little research in the area of using such information or motivational indices to predict academic success in graduate school, particularly at the Master's Degree level. It is hoped that this study will solve some of these problems and provide additional information regarding a realistic basis for selection of officers to the Communications Management curriculum at the U. S. Naval Postgraduate School.

III. RESEARCH PROCEDURES

The research procedures consist of data collection and analysis. This chapter contains a description of these procedures. The next chapter describes the results.

A. DATA COLLECTION

1. Biographical Questionnaire

The Questionnaire (Appendix A) was developed by Professor R. A. Weitzman with assistance from this author. It was designed to obtain the following information:

a. Source of commission and/or prior enlisted service.

b. Rank.

c. Warfare specialty.

d. Undergraduate institution attended, degree received, undergraduate major, and grade-point average.

e. Race.

f. Religion.

g. Height and weight.

h. Marital status and/or sex of dependents.

i. Birth-order of subject.

j. Educational level of father, mother, and wife.

k. Military career of father.

l. High school background information.

m. Personal habits of smoking and/or drinking.

n. Participation in the Boy Scouts and rank attained.

o. Designation by Postgraduate Selection Board.

p. Satisfaction with the Naval Postgraduate School (NPS) and/or curriculum.

q. Possible future use of skills obtained at NPS.

r. Mathematics background.

s. Motivation for coming to NPS.

The questionnaire was made in the form of a booklet containing 61 questions, with a separate answer sheet enclosed. The answer sheet was developed using a utility layout form from the Optical Scanning Corporation of Newton, Pennsylvania; over-printing on the form using special non-reflective red ink was done to gather information from each respondent as to his social security number, undergraduate institution attended, number of quarters completed at NPS, total QPR, and curriculum number. The remainder of the answer sheet was used to obtain "yes" or "no" responses to the 61 biographical questions.

The printing of the questions to match the spaces on the utility form was done with a "composer" typewriter. The answer sheet was enclosed within the booklet, and the pages containing the questions were successively shorter so that only the appropriate "yes" "no" columns of the answer sheet were exposed. This was done to reduce possible errors on the part of respondents.

The biographical questionnaire was distributed at the same time as the SVIB and both were completed by respondents on a take-home-and-return basis as there was no time limit on either of the two instruments.

The biographical answer sheets were separated, checked for completeness, and processed by an optical scanner in combination with a card puncher, both of which are located in the NPS W. R. Church Computer Center. The process yielded one punched IBM data card per subject. The error rate was approximately 20%, and those answer sheets in error were hand-checked. Incomplete errasures, and too heavy or too light marks accounted for the errors. This phase was completed on 25 February 1974.

2. Strong Vocational Interest Blank

The Strong Vocational Interest Blank for Men, Form T-399 (revised 1966) was used to obtain information on the interests of each of the 42 subjects.

The SVIB was distributed to all three sections of Communications Management between 10 December 1973 and 20 January 1974. Answer sheets were sent to the Naval Personnel Research and Training Laboratory, San Diego, California, on 1 February for scoring. A computer print out of each subject's standard SVIB scores on all 56 occupational and 9 non-occupational scales, plus seven data cards per person containing the standard plus raw scores on each of the 65 scales was received on 25 February 1974.

Each subject was provided a copy of his SVIB occupational scores. A Fortran program was written to reduce the seven data cards per person to two data cards per person; standard scores were used and the raw scores eliminated.

3. Graduate Record Examination

The GRE (aptitude) was administered to all subjects between 19 February and 24 March 1974. All answer sheets were returned to Educational Testing Service (ETS), Princeton, New Jersey, by 24 March. All scores were returned to NPS by 22 April on a master listing, and each subject received a copy of his scores from ETS. These scores were put on IBM data cards and this phase completed by 22 April 1974.

4. Undergraduate Academic Performance

The grade-point average for each subject's four undergraduate school years was computed from his transcript, which was on file in the Registrar's office. All grades were converted to the NPS method of computing QPR's (4.0 = A, 3.0 = B, 2.0 = C, etc.). This phase made this author aware of some of the problems encountered by the Postgraduate Selection Board. The major problem here was that all schools do not use the same grading system; e.g., some use the 4.0 system as NPS, other use a 3.0--there was even an inverted 4.0 in which a 4.0 = F, as well as several 5.0 systems. This information was also placed on IBM data cards, and this phase was completed by 15 March 1974.

5. Undergraduate Institution "Figure on Merit"

A "figure of merit" (FOM) was devised to represent the academic rigor of each undergraduate institution attended by the subjects. The FOM figure was the mean Scholastic Aptitude Test (SAT) scores of the freshmen admitted to each of 986 colleges and universities within the United States. [33]

6. Educational Potential Code

The EPC was calculated for each individual using the same criteria used by the Postgraduate Selection Board (actual EPC's were not available). The criteria for calculating the EPC (see Appendix B) were verified by the NPS Registrar's office, who compute EPC's for all NROTC and U. S. Naval Academy graduates each year.

If current procedures for selection are to be improved, it is first necessary to check the validity of the EPC as a predictor of academic performance.

7. Satisfaction

Satisfaction was quantitatively defined by a certain response to four questions on the biographical questionnaire as follows:

	QUESTION	SATISFACTION RESPONSE	
47.	Do you wish to serve in a billet requiring the education that you would receive at a graduate school?	YES	= +1
55.	Are you satisfied with your education at NPS?	YES	= +1
59.	Do you now like your degree curriculum?	YES	= +1
60.	If you could start over again, would you choose a different curriculum?	NO	= +1

Thus, the range of "satisfaction" runs from 0 meaning not satisfied, to +4 meaning satisfied.

B. METHOD OF ANALYSIS

The results were tabulated and analyzed by three computer programs written by this author, one program written by Professor Weitzman, and two packaged computer programs: SNAP/IEDA [34] and the Statistical Package for the Social Sciences (SPSS) [35]. These programs provided an informative overview of the large volume of data. Although there were only 42 subjects in the sample, there were over 140 variables to be considered for each subject.

QPR's for all subjects were tabulated separately by section as the three sections had completed one, three, and five quarters, respectively. It was observed that the mean and standard deviation for each section generally increased and shrank, respectively, as the number of quarters completed increased. A standardized Z value of QPR was thus calculated for each subject using his section's mean and standard deviation. This standardized Z value replaced the QPR for all analyses (see Appendix C).

Several computer runs were made for all 42 subjects to check for errors. Two noteworthy facts appeared: first, 13 out of the 42, or 31% were never selected as "Primary" or "Alternate" for any curriculum by the Postgraduate Selection Board; second, two subjects reported they had an A or A- undergraduate GPA, when, in fact, no subject had an undergraduate GPA greater than 3.23 (using NPS method of computing QPR).

A stratified random sample of 12 subjects was selected from the 42 as a hold-out group for cross-validation. Stratification was by section. The remaining thirty subjects were used as the developmental sample for the initial analysis.

Scatter plots were obtained for all variables to check for any curvilinear relationships; none were found.

The objective of the analysis was to predict each of two criteria: academic performance (QPR) and satisfaction, as previously defined. The three major instruments, plus undergraduate academic performance were first analyzed separately, then in combination with each other, and finally all data were combined. Analysis was accomplished using stepwise miltiple-regression to predict the two criteria.

IV. PRESENTATION OF DATA

The current method of using the Educational Potential Code (EPC) as a predictor of academic performance (QPRZ) produced a correlation coefficient (r) of .34 for N = 42, which is significant at or beyond the .05 level. The EPC as a predictor of satisfaction produced an r = .14.

All correlation coefficients and predicting equations presented subsequently in this section were determined from the developmental group (N = 30), and all cross-validation correlation coefficients were computed from the hold-out group (N = 12). Throughout this section the following symbols will be used:

* Significant at or beyond the .05 level.

** Significant at or beyond the .01 level.

moreover, S.E. will denote standard error.

The degrees of freedom (df) for the regression equations are as follows:

The numerator df is equal to the number of steps in the regression equation; the denominator df to (sample size) - (number of steps) + 1.

Only the correlation coefficients above .25 will be reported here; Appendix D contains a complete list of correlation coefficients for N = 42.

The heading "Variable Entered" will list in order the variables as they came into the multiple-regression equation.

Biographical items will be listed as follows: BIO 16 to represent biographical question number 16, and 4 GPA to represent the 4th year grade-point average in college. The SVIB scales will be listed by their occupational or non-occupational scale name.

A. PREDICTORS OF ACADEMIC PERFORMANCE

1. Biographical Questionnaire

The correlation coefficients in the following table were calculated by SPSS using Pearson product-moment method. A separate program was written by this author to verify that the correlation coefficients calculated by SPSS on 0,1 data are point-biserial correlation coefficients. They are.

The table contains the results of correlations between QPRZ and some of the biographical questions. QPRZ is a standardized Z value of QPR calculated for each subject using his section's mean and standard deviation (See Appendix C).

QUESTION NUMBER	r with QPRZ
4	-.27
13	.27
16	-.33
17	.25
19	.28
22	.25
24	.26
37	.45*
38	.26

Two separate sets of stepwise multiple-regression equations were determined by SPSS. The first was developed utilizing "face-valid" and "available" questions, which were defined as question 1-16, 22, and 44. The second set of equations was developed utilizing all biographical questions. The following two tables contain the results of these analyses together with cross-validation results.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
BIO 16	1	.33	1.02	3.56	-.20
BIO 4	2	.43	.99	3.17	-.18
BIO 10	3	.55	.93	3.88*	-.14
BIO 22	4	.59	.92	3.36*	.004
BIO 1	5	.66	.87	3.81*	.16
BIO 7	6	.69	.86	3.54*	.11
BIO 6	7	.72	.83	3.54*	-.19
BIO 6,11,15	10	.77	.83	2.87*	-.14

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
BIO 37	1	.45	.96	7.42*	.25
BIO 19	2	.56	.91	6.21**	.24
BIO 2	3	.61	.88	5.25**	.18
BIO 13	4	.67	.84	5.18**	.02
BIO 11	5	.73	.79	5.55**	.02
BIO 53	6	.78	.74	6.02**	.15
BIO 9	7	.83	.67	7.10**	.26
BIO 33,35,60	10	.95	.38	20.4**	.31

None of the stepwise multiple-regression equations produced a cross-validated r that was significant.

Stepwise pattern analysis was used on the developmental group and yielded the following results:

The first question which pattern analysis selected was 37 and its correlation with the criterion was .45*; the second question selected was 2, and in combination with the first it yielded a correlation of .65** with the criterion.

QUESTION NUMBER		PATTERN SCORE		NUMBER OF RESPONDENTS HAVING PATTERN
37	2			
RESPONSE		QPRZ	QPR	
NO	NO	- .62	3.11	3
NO	YES	-1.90	2.74	2
YES	NO	- .19	3.24	16
YES	YES	.77	3.53	9

These patterns and associated pattern scores (using QPRZ) were cross-validated with the hold-out sample and produced a cross-validation r = .05, which is not statistically significant.

Question 37 was also the first question selected in the stepwise multiple-regression, and the correlations with the criterion were identical. This question, although "face-valid," is not currently "available" in an officer's record. If further analysis demonstrates continued significance, then this information should be made available to the Navy.

2. Strong Vocational Interest Blank

Simple (Pearson) correlations and stepwise multiple-regression equations were determined by SPSS for the Strong Vocational Interest Blank (SVIB) scales and yielded the following results, respectively:

OCCUPATION/NON-OCCUPATIONAL SCALE	r with QPRZ
Naval Officer	.38*
Veterinarian	-.25

OCCUPATION/NON-OCCUPATIONAL SCALE	r with QPRZ
Policeman	-.26
Public Administrator	.26
YMCA Secretary	-.28
Music Performer	-.40*
CPA Owner	.40*
Senior CPA	.52**
Accountant	.29
Computer Programmer	.44*
M-F	.26

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
Senior CPA	1	.52	.92	10.54**	.33
Biologist	2	.58	.89	7.04**	.10
Artist	3	.63	.86	5.89**	.14
Math-Science Teacher	4	.76	.73	8.97**	-.01
Dentist	5	.82	.67	9.8**	-.19
Ad. Man	6	.84	.64	9.6**	-.24
Architect Interpreter Banker Naval Officer	10	.93	.45	14.2**	-.27

None of the stepwise multiple-regression equations produced a cross-validated r that was significant.

3. Graduate Record Examination

Simple correlations and stepwise multiple regression-equations were determined by SPSS with the following respective results:

GRE TEST (APTITUDE)	r with QPRZ
Verbal	.06
Quantitative	.32
Verbal + Quantitative	.21

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
Quantitative	1	.32	1.02	3.31	.03
Verbal	2	.32	1.04	1.63	-.03

The third variable (verbal + quantitative) would not enter the regression equation because the F-level to enter was too low.

Appendix E contains cumulative-frequency distributions, means and standard deviations of the GRE aptitude tests.

4. Undergraduate Academic Performance

The undergraduate academic performance was assessed two ways. The first was from the Biographical Questionnaire Questions 15 and 16. As previously noted, two individuals reported they had an A or A- average in college when, in fact, no person had a grade-point average greater than 3.23 on a

4.0 grading system. Thus the validity of self-reported grades from college was questioned. The second method of assessment was from actual college transcripts; the results of this method are reported here. F O M stands for Figure of Merit; see page 32 for further explanation.

VARIABLE	r with QPRZ
4 GPA	.49**
FOM	.34
2 GPA x FOM	.32
4 GPA x FOM	.58**

The variable in the fourth row of this table suggests that knowledge of the undergraduate institution a person attended constitutes valuable information for predicting academic success.

Stepwise multiple regression yielded the following results:

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
4 GPA x FOM	1	.58	.88	14.63**	.14
3 GPA	2	.66	.82	10.7**	.21
2 GPA x FOM	3	.68	.81	7.81**	.24
FOM	4	.69	.82	5.9**	.19
4 GPA	5	.75	.77	6.3**	.12

None of the cross-validated r's were significant.

5. Combinations of Instruments

Since simple correlations have been reported in previous sections, they will not be included here; only the multiple correlation coefficients and corresponding cross-validation results will be reported in this section.

a. Biographical Questionnaire Plus Strong Vocational Interest Blank

The combination of the Biographical Questionnaire items with SVIB scales was tested to see if non-academic measures could be utilized to predict academic performance.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
Senior CPA	1	.52	.92	10.54**	.33
BIO 16	2	.62	.86	8.67**	-.39
BIO 4	3	.70	.80	8.33**	-.34
BIO 11	4	.72	.78	7.07**	-.30
Printer	5	.75	.76	6.45**	-.34
Occn-Level	6	.81	.69	7.47**	-.33
BIO 2	7	.84	.66	7.68**	-.28
Ad. Man	8	.87	.61	8.24**	-.40

None of the results of cross-validation were significant.

b. Biographical Questionnaire Plus Graduate Record Examination

The combination fo biographical information and Graduate Record Examination results has been used extensively by academic institutions to select applicants for admission. This section presents the results of using this method to assess potential for academic performance.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
BIO 16	1	.33	1.02	3.56	-.20
GRE Quantitative	2	.49	.95	4.47*	-.39
BIO 4	3	.55	.94	3.75*	-.28
BIO 10	4	.62	.90	3.92*	-.17
BIO 11	5	.66	.87	3.87*	-.18
BIO 6	6	.70	.84	3.79**	-.37
BIO 15	7	.72	.84	3.45**	-.26
BIO 5	8	.74	.84	3.17*	-.16

No cross-validation correlations were statistically significant. All the cross-validated r's in fact were negative, which suggests a trend different from what other academic institutions have found.

c. Biographical Questionnaire Plus Undergraduate Academic Performance

This combination of instruments has also been used by academic institutions to select applicants. The FOM was not included in this analysis as its use had proved not to be significant in a previous analysis reported earlier.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
4 GPA	1	.49	.94	8.78**	.25
BIO 22	2	.66	.82	10.5**	.56
3 GPA	3	.75	.74	11.3**	.578*
BIO 1	4	.77	.72	9.4**	.635*
BIO 6	5	.78	.72	7.86**	.56

Following are the equations that produced significant results in cross-validation:

QPRZ PREDICTED = -3.8 + (4 GPA x 2.29(+ (BIO 22 x 1.29) -
(3 GPA x 1.21)

QPRZ PREDICTED = -3.68 + (4 GPA x 2.04) + (BIO 22 x 1.67) -
(3 GPA x .98) - (BIO 1 x .73)

The first of these is the 3-step equation; the second, the 4-step.

d. Strong Vocational Interest Blank Plus Graduate Record Examination

The step-wise multiple-regression equations for the first eight steps yielded the same results for the SVIB plus

GRE as reported earlier for the SVIB by itself. As previously noted, no cross-validation correlation coefficients were significant.

e. Strong Vocational Interest Blank Plus Undergraduate Academic Performance

The following table presents the results of multiple-regression determined by SPSS for the SVIB plus undergraduate academic performance.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
4 GPA x FOM	1	.58	.88	14.63**	.14
Senior CPA	2	.69	.79	12.7**	.03
3 GPA x FOM	3	.75	.74	11.03**	.18
Banker	4	.78	.71	9.75**	.14
Accountant	5	.80	.69	8.83**	.03
Computer Pgmr	6	.84	.64	9.24**	.20
CPA Owner	7	.86	.61	9.29**	.21
Soc. Sci. Teacher	8	.88	.58	9.49**	.20

No results were significant in cross-validation.

f. Graduate Record Examination Plus Undergraduate Academic Performance

As previously reported in the Background Section, the GRE in some combination with undergraduate academic performance usually gives a multiple correlation in the .4 area.

Results of this author's investigation using multiple-regression equations determined by SPSS yielded the following results.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
4 GPA	1	.49	.94	8.78**	.25
GRE Quant.	2	.63	.85	8.94**	.27
F.O.M.	3	.71	.78	9.14**	.09
3 GPA	4	.74	.76	7.87**	.13
GRE Verbal	5	.76	.75	6.91**	.04
2 GPA	6	.79	.72	6.53**	.10

No results were significant in cross-validation.

g. All Variables

SPSS limits the user to a maximum of 82 variables in a regression equation. Since there were 140 variables available, this author used the term "all variables" to denote the following: the 18 "face valid" biographical questions, as previously defined, the 56 SVIB occupational scale scores, the undergraduate academic performance (with FOM weighting included), plus the two GRE scores.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
4 GPA x FOM	1	.58	.88	14.63**	.14
GRE Quant.	2	.70	.78	13.04**	.17
BIO 16	3	.74	.75	10.98**	.33
BIO 11	4	.78	.70	10.63**	.53
Music Perfor.	5	.83	.66	10.39**	.41
3 GPA x FOM	6	.85	.63	9.98**	.38
Army Officer	7	.87	.60	9.77**	.13
1 GPA x FOM	8	.89	.57	9.94**	-.05
BIO 22	9	.90	.55	9.85**	-.22
Accountant	10	.91	.53	9.54**	-.48

No results were significant in cross-validation.

B. PREDICTORS OF SATISFACTION

The following two tables contain simple (Pearson) r's and stepwise multiple-regression R's for the prediction of satisfaction, measured by the total number of favorable responses to items 47, 55, 59 and 60 on the Biographical Questionnaire; see Research Procedure, Satisfaction Section, for further details.

1. Biographical Questionnaire

As previously mentioned in the Prediction of Academic Performance Section, SPSS calculates correlation coefficients on 0,1 data as point-biserial correlation coefficients. The

following tables contain the correlation coefficients and multiple-regression results determined by SPSS for the biographical data.

QUESTION NUMBER	r with SATISFACTION
14	.43*
16	-.33
17	.27
37	.26
45	.55**
46	.44*
49	.26
54	.35
56	.38*

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
BIO 45	1	.55	.93	12.33**	.33
BIO 56	2	.68	.83	11.82**	.35
BIO 14	3	.74	.78	10.44**	.23
BIO 6	4	.78	.74	9.84**	.34
BIO 16	5	.82	.69	9.87**	.15
BIO 9	6	.84	.67	9.16**	.20
BIO 27	7	.87	.62	10.0**	.32
BIO 39	8	.89	.57	10.5**	.38

No cross-validation correlation coefficients were statistically significant.

Stepwise pattern analysis was used on the developmental sample and cross-validated with the hold-out sample and yielded the following results:

The first question which pattern analysis selected was 45, and its correlation with the criterion was .55**; the second question selected was 56, and combined with the first, it yielded a correlation of .68** with the criterion.

QUESTION NUMBER		PATTERN SCORE	NUMBER OF RESPONDENTS HAVING PATTERN
45	56		
RESPONSE			
NO	NO	-	0
NO	YES	0	1
YES	NO	1	1
YES	YES	3	28

These patterns and associated pattern scores were cross-validated with the hold-out sample and produced a cross-validated r = .38, which is not statistically significant. Questions 45 and 56 were also the first two questions selected in the stepwise multiple-regression procedure, and the correlations with the criterion were identical. Pattern analysis was used to select only two questions for pattern scores because the r with the criterion began to shrink drastically as the number of questions in the pattern increased past two, apparently because of the samll sample size of N = 30.

2. Strong Vocational Interest Blank

The following two tables provide corresponding information on the SVIB as a predictor of satisfaction. Presented are simple correlations and multiple-regression results as determined by SPSS.

OCCUPATIONAL/NON-OCCUPATIONAL SCALES	r with SATISFACTION
Physical Therapist	.32
Librarian	-.27
Advertising Man	-.35
Author-Journalist	-.37*
Interpreter	-.41*

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
Interpreter	1	.41	1.02	5.73*	.30
Pres. Mfg. Conc.	2	.48	1.00	4.16*	.27
Psychiatrist	3	.52	.99	3.21*	.18
CPA Owner	4	.55	.98	2.77*	.22
Phys. Thera.	5	.60	.96	2.81*	.12
Biologist	6	.69	.89	3.57*	.09
Credit Mgr.	7	.74	.84	4.02*	-.03
Music Perform	8	.80	.76	4.86**	.03
Engineer	9	.85	.69	5.92**	.03
Chemist	10	.88	.62	7.13**	.25

None of the cross-validation correlation coefficients were statistically significant.

3. Graduate Record Examination Plus Undergraduate Academic Performance

Although ability of achievement measures do not appear to have face validity when considering a criterion such as satisfaction, the theory that a person who does well academically would be satisfied in an academic environment has been expressed by many people. This section presents results that bear on such a theory as applied to Communications Management students at the U. S. Naval Postgraduate School.

VARIABLE	r with SATISFACTION
GRE Verbal	-.34
4 GPA x FOM	-.28
GRE Verbal + Quantitative	-.25

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
GRE Verbal	1	.34	1.05	3.81	.23
See Note	2	.45	1.02	3.43*	.25
GRE Quant.	3	.48	1.02	2.61	.26
QPRZ	4	.49	1.03	2.01	.27
4 GPA x FOM	5	.53	1.02	1.93	.25
3 GPA	6	.58	1.00	2.03	.12
2 GPA	7	.59	1.02	1.70	.09

Note - ((1 GPA + 2 GPA) - (3 GPA + 4 GPA)) x F.O.M..

No cross-validation correlation coefficients were statistically significant.

4. All Variables

This analysis was done twice, using two different sets of variables. The first consisted of "face-valid" and "available" biographical questions plus the 56 SVIB occupational scale scores, undergraduate academic performance, and the two GRE scores; the second, of biographical questions 45 and 56, which were the two questions selected by pattern analysis and multiple-regression, plus the 56 SVIB occupational scale scores, undergraduate academic performance, and the two GRE scores.

Since all correlations have been reported in previous sections, they will not be included here; only the stepwise multiple R's and the corresponding cross-validation results will be reported in this section.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
BIO 14	1	.43	1.01	6.41*	.21
BIO 16	2	.56	.94	6.39**	-.40
Phys. Thera.	3	.65	.88	6.33**	-.40
BIO 6	4	.71	.83	6.50**	-.25
Soc. Worker	5	.77	.77	6.96**	-.18
GRE Quant.	6	.80	.73	7.10**	-.15
3 GPA x FOM	7	.83	.69	7.41**	-.11
BIO 3	8	.86	.65	7.75**	-.06
BIO 2	9	.88	.62	7.91**	-.08
BIO 22	10	.90	.57	8.89**	.17

No cross-validation correlations were statistically significant.

Question 56 was added to the list of "face-valid" questions to see what, if any, effect there was upon satisfaction if the respondent was in the curriculum of his first or second choice. There was no effect; the same results as presented above were obtained and question 56 never appeared in any of the ten steps of the stepwise multiple-regression analysis.

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL	CROSS-VALIDATED r
BIO 45	1	.55	.93	12.33**	.33
BIO 56	2	.68	.83	11.82**	.35
Phys. Thera.	3	.71	.81	8.91**	.16
Psychiatrist	4	.74	.79	7.84**	.26
YMCA Sec.	5	.78	.75	7.60**	.26
Rec. Admin.	6	.81	.72	7.28**	.22
Biologist	7	.84	.69	7.50**	.22
Forest Svc.	8	.87	.63	8.26**	.29
Attorney	9	.88	.63	7.69**	.25
Ad. Man	10	.89	.60	7.77**	.13

No cross-validation correlation coefficients were statistically significant.

C. SUMMARY OF SIGNIFICANT FINDINGS

The current method of using the Educational Potential Code (EPC) as a predictor of academic performance (QPRZ) produced a correlation coefficient of .34 for N = 42, which is statistically significant at or beyond the .05 level. This accounts for approximately 12% of the variance in academic performance of Communications Management students at the Naval Postgraduate School.

Investigation using biographical information, the Strong Vocational Interest Blank, the Graduate Record Examination, and undergraduate academic performance yielded two multiple-regression equations that produced statistically significant results in cross-validation.

These equations involved only biographical and undergraduate academic performance variables.

The four-variable equation produced the higher multiple correlation coefficient of .77 in the developmental sample (N = 30). In the hold-out sample (N = 12), the cross-validated correlation coefficient, which was also the higher, was .63, which is significant at the .013 level.

The four variables were:

4 GPA --- 4th year undergraduate grade-point average

3 GPA --- 3rd year undergraduate grade-point average

BIO 1 --- graduate of the U. S. Naval Academy?

BIO 22 --- undergraduate major in engineering?

To develop a more powerful selection method, the developmental sample and the hold-out sample were combined (N = 42) to produce a new stepwise multiple-regression equation using

the same four variables:

QPRZ PREDICTED = -3.632 + (4 GPA x 1.746) + (BIO 22 x 1.454)
- (BIO 1 x .6546) - (3 GPA x .606)

The results for this equation were as follows:

VARIABLE ENTERED	NUMBER OF STEPS	MULTIPLE R	S.E.	F-LEVEL
4 GPA	1	.44**	.89	9.66**
BIO 22	2	.64**	.78	13.66**
BIO 1	3	.69**	.74	11.61**
3 GPA	4	.72**	.72	10.26**

The correlation between the Step 4 predicted QPRZ's and the actual QPRZ's was .725, which is significant at or beyond the .01 level.

This accounts for approximately 53% of the variance in academic performance of Communications Management students, as opposed to the EPC, which accounts for 12% of the variance.

Since a more readily usable form of prediction than the multiple-regression equation was deemed necessary if the results of this study were to be useful for selection, four tables and two empirically developed expectancy charts were developed. These tables and charts are presented in Section V (Conclusion).

The tables were developed by transforming the predicted standardized Z value of QPR, to the actual QPR scale as follows:

$$\text{PREDICTED QPR} = \text{MEAN(QPR)} + \frac{\text{SD(QPR)} \times (\text{PRED. QPRZ} - \text{MEAN PRED. QPRZ})}{\text{SD(PRED. QPRZ)}}$$

where MEAN(QPR) and SD(QPR) were determined from the actual QPR's of the entire group (N = 42).

The results of this study would, in all probability, be more significant had the sample been taken from prospective applicants for the Communications Management curriculum. The sample in this study had already been through a screening process and thus is more homogeneous and, perhaps, as a group, more academically able than the population of naval officers as a whole. This restriction of range combined with the small sample size increased the difficulty of developing a significant prediction model. The prediction model developed under these conditions is thus more compelling than the statistics presented indicate.

V. CONCLUSION

A. GENERAL

The following statements apply only to students in the Communications Management curriculum.

1. "Satisfaction" was not predictable with any degree of accuracy.

2. The current method of using the Educational Potential Code as a predictor of academic performance accounted for approximately 12% of the variance in academic performance.

3. The method developed in this study for predicting academic performance accounted for approximately 53% of the variance in academic performance.

4. Four tables and two expectancy charts for predicting academic performance, presented in the following section, represent an in-depth analysis of one hundred and forty variables. Four of these variables, which are currently available to the Postgraduate Selection Board from undergraduate transcripts, dominate in their predictive potential over the current method to the extent that the method developed in this study is four times more valid than the current method and would require less time than the current method.

These results clearly indicate that naval officers obtaining a high predicted QPR from the tables are much more likely to succeed in the Communications Management curriculum than those obtaining a low predicted QPR. Consequently, it

appears that the use of this method of screening applicants for selection could contribute to the goal of increasing the number of naval officers who could successfully complete the curriculum, attain a graduate degree, and ultimately be assigned a P-code in Communications Management.

B. HOW TO USE THE METHOD DEVELOPED

Four tables are presented in this section which facilitate the use of the method developed in this study. Each table begins with two questions (the two biographical variables). If the answer to these two questions is correct, the user has the appropriate table. The user then enters the table with the remaining two variables, 3rd and 4th year undergraduate grade-point averages (based on a 4.0 system), and emerges with a predicted QPR in the Communications Management curriculum. It will be noted that some tables have a predicted QPR greater than 4.0; this is due to the large proportion of the sample having relatively low undergraduate academic performance (mean GPA was 2.47) who as graduate students had significantly higher academic performance (mean QPR was 3.33).

A linear transformation of a 3.40 undergraduate grade-point average would place the individual beyond a 4.0 QPR, if such a thing were possible. Limiting the tables to a maximum score of 4.0 would eliminate valuable information and reduce the predictive potential of the developed method.

An expectancy chart is a graphic display of data presenting the probability or likelihood of attaining a defined level of "superiority." The chart is determined from the relationship

that exists between a predictor and a criterion. There are two types of expectancy charts: institutional and individual. Institutional expectancy charts are used for decisions like the selection of employees or the admission of applicants to a training program. The institutional expectancy chart presented here (Figure 1, page 66) permits the decision maker to forecast the results of his decision. If he wanted to select the best 40% of available applicants, he would select those who had a predicted QPR, from the tables, of 3.38 or greater, and he would know that 76% of those selected would, in all probability, be rated "superior." The individual expectancy chart (Figure 2, page 66), useful for vocational guidance, shows an individual's chances of success (achieving superiority).

"Superiority" is defined as the level of academic achievement of students who had a QPR equal to or greater than the median QPR of the 42 subjects in the sample.

IF UNDERGRADUATE MAJOR IN ENGINEERING = YES

AND

IF GRADUATE OF U.S. NAVAL ACADEMY = YES

		4TH YEAR COLLEGE GPA											
		1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
3RD YEAR COLLEGE GPA	1.8	3.04	3.18	3.31	3.44	3.58	3.71	3.84	3.98	4.11	4.24	4.38	4.51
	2.0	3.00	3.13	3.26	3.40	3.53	3.66	3.80	3.93	4.06	4.20	4.33	4.46
	2.2	2.95	3.08	3.22	3.35	3.48	3.62	3.75	3.88	4.02	4.15	4.28	4.42
	2.4	2.90	3.04	3.17	3.30	3.44	3.57	3.70	3.84	3.97	4.10	4.24	4.37
	2.6	2.86	2.99	3.12	3.26	3.39	3.52	3.66	3.79	3.92	4.06	4.19	4.32
	2.8	2.81	2.94	3.08	3.21	3.34	3.48	3.61	3.74	3.88	4.01	4.14	4.28
	3.0	2.76	2.90	3.03	3.16	3.30	3.43	3.56	3.70	3.83	3.96	4.10	4.23
	3.2	2.72	2.85	2.98	3.12	3.25	3.38	3.52	3.65	3.78	3.92	4.05	4.18
	3.4	2.67	2.81	2.94	3.07	3.20	3.34	3.47	3.60	3.74	3.87	4.00	4.14
	3.6	2.63	2.76	2.89	3.03	3.16	3.29	3.43	3.56	3.69	3.83	3.96	4.09
	3.8	2.58	2.71	2.85	2.98	3.11	3.25	3.38	3.51	3.65	3.78	3.91	4.05
	4.0	2.53	2.67	2.80	2.93	3.07	3.20	3.33	3.47	3.60	3.73	3.87	4.00

IF UNDERGRADUATE MAJOR IN ENGINEERING = YES

AND

IF GRADUATE OF U.S. NAVAL ACADEMY = NO

4TH YEAR COLLEGE GPA

3RD YEAR COLLEGE GPA	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
1.8	3.29	3.43	3.56	3.69	3.83	3.96	4.09	4.22	4.36	4.49	4.62	4.76
2.0	3.25	3.38	3.51	3.65	3.78	3.91	4.05	4.18	4.31	4.45	4.58	4.71
2.2	3.20	3.33	3.47	3.60	3.73	3.87	4.00	4.13	4.27	4.40	4.53	4.67
2.4	3.15	3.29	3.42	3.55	3.69	3.82	3.95	4.09	4.22	4.35	4.49	4.62
2.6	3.11	3.24	3.37	3.51	3.64	3.77	3.91	4.04	4.17	4.31	4.44	4.57
2.8	3.06	3.19	3.33	3.46	3.59	3.73	3.86	3.99	4.13	4.26	4.39	4.53
3.0	3.01	3.15	3.28	3.41	3.55	3.68	3.81	3.95	4.08	4.21	4.35	4.48
3.2	2.97	3.10	3.23	3.37	3.50	3.63	3.77	3.90	4.03	4.17	4.30	4.43
3.4	2.92	3.05	3.19	3.32	3.45	3.59	3.72	3.85	3.99	4.12	4.25	4.39
3.6	2.88	3.01	3.14	3.28	3.41	3.54	3.68	3.81	3.94	4.07	4.21	4.34
3.8	2.83	2.96	3.10	3.23	3.36	3.50	3.63	3.76	3.90	4.03	4.16	4.30
4.0	2.78	2.92	3.05	3.18	3.32	3.45	3.58	3.72	3.85	3.98	4.12	4.25

IF UNDERGRADUATE MAJOR IN ENGINEERING = NO

AND

IF GRADUATE OF U.S. NAVAL ACADEMY = YES

4TH YEAR COLLEGE GPA

3RD YEAR COLLEGE GPA	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
1.8	2.49	2.62	2.75	2.89	3.02	3.15	3.29	3.42	3.55	3.69	3.82	3.95
2.0	2.44	2.57	2.71	2.84	2.97	3.11	3.24	3.37	3.51	3.64	3.77	3.91
2.2	2.39	2.53	2.66	2.79	2.93	3.06	3.19	3.33	3.46	3.59	3.73	3.86
2.4	2.35	2.48	2.61	2.75	2.88	3.01	3.15	3.28	3.41	3.55	3.68	3.81
2.6	2.30	2.44	2.57	2.70	2.84	2.97	3.10	3.24	3.37	3.50	3.64	3.77
2.8	2.26	2.39	2.52	2.66	2.79	2.92	3.06	3.19	3.32	3.46	3.59	3.72
3.0	2.21	2.34	2.48	2.61	2.74	2.88	3.01	3.14	3.28	3.41	3.54	3.68
3.2	2.16	2.30	2.43	2.56	2.70	2.83	2.96	3.10	3.23	3.36	3.50	3.63
3.4	2.12	2.25	2.38	2.52	2.65	2.78	2.92	3.05	3.18	3.32	3.45	3.58
3.6	2.07	2.20	2.34	2.47	2.60	2.74	2.87	3.00	3.14	3.27	3.40	3.54
3.8	2.02	2.16	2.29	2.42	2.56	2.69	2.82	2.96	3.09	3.22	3.36	3.49
4.0	1.98	2.11	2.24	2.38	2.51	2.64	2.78	2.91	3.04	3.18	3.31	3.44

IF UNDERGRADUATE MAJOR IN ENGINEERING = NO

AND

IF GRADUATE OF U.S. NAVAL ACADEMY = NO

4TH YEAR COLLEGE GPA

3RD YEAR COLLEGE GPA	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0
1.8	2.74	2.87	3.00	3.14	3.27	3.40	3.54	3.67	3.80	3.94	4.07	4.20
2.0	2.69	2.82	2.96	3.09	3.22	3.36	3.49	3.62	3.76	3.89	4.02	4.16
2.2	2.64	2.78	2.91	3.04	3.18	3.31	3.44	3.58	3.71	3.84	3.98	4.11
2.4	2.60	2.73	2.86	3.00	3.13	3.26	3.40	3.53	3.66	3.80	3.93	4.06
2.6	2.55	2.69	2.82	2.95	3.09	3.22	3.35	3.48	3.62	3.75	3.88	4.02
2.8	2.51	2.64	2.77	2.91	3.04	3.17	3.31	3.44	3.57	3.71	3.84	3.97
3.0	2.46	2.59	2.73	2.86	2.99	3.13	3.26	3.39	3.53	3.66	3.79	3.93
3.2	2.41	2.55	2.68	2.81	2.95	3.08	3.21	3.35	3.48	3.61	3.75	3.88
3.4	2.37	2.50	2.63	2.77	2.90	3.03	3.17	3.30	3.43	3.57	3.70	3.83
3.6	2.32	2.45	2.59	2.72	2.85	2.99	3.12	3.25	3.39	3.52	3.65	3.79
3.8	2.27	2.41	2.54	2.67	2.81	2.94	3.07	3.21	3.34	3.47	3.61	3.74
4.0	2.23	2.36	2.49	2.63	2.76	2.89	3.03	3.16	3.29	3.43	3.56	3.69

EXPECTANCY CHARTS

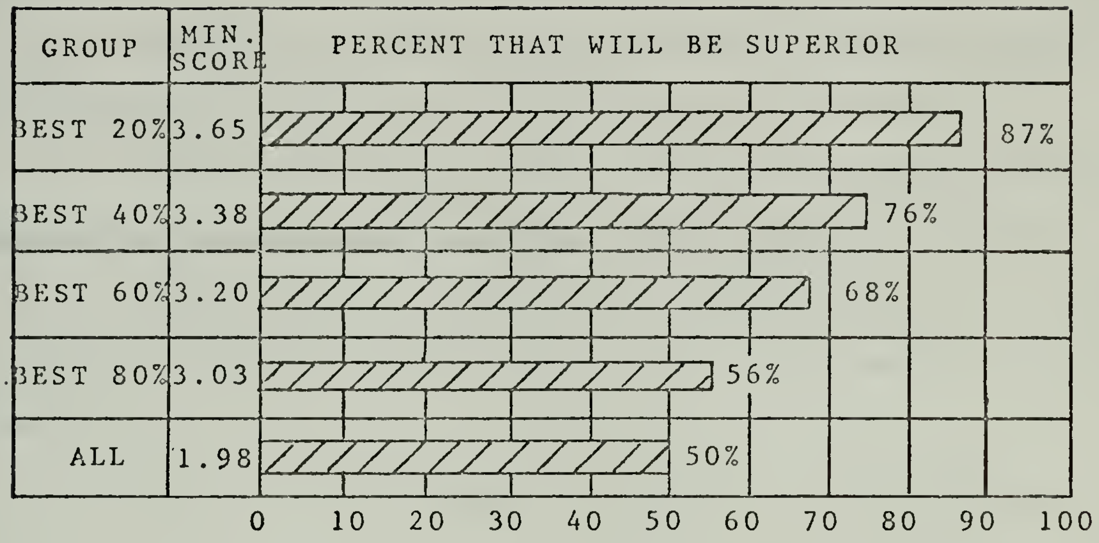


FIG. 1. EXPECTANCY CHART FOR INSTITUTIONAL PREDICTION BASED ON THE RESULTS OF THE TABLES FOR PREDICTING QPR. THOSE RATED AVERAGE OR ABOVE AVERAGE WERE CONSIDERED SUPERIOR.

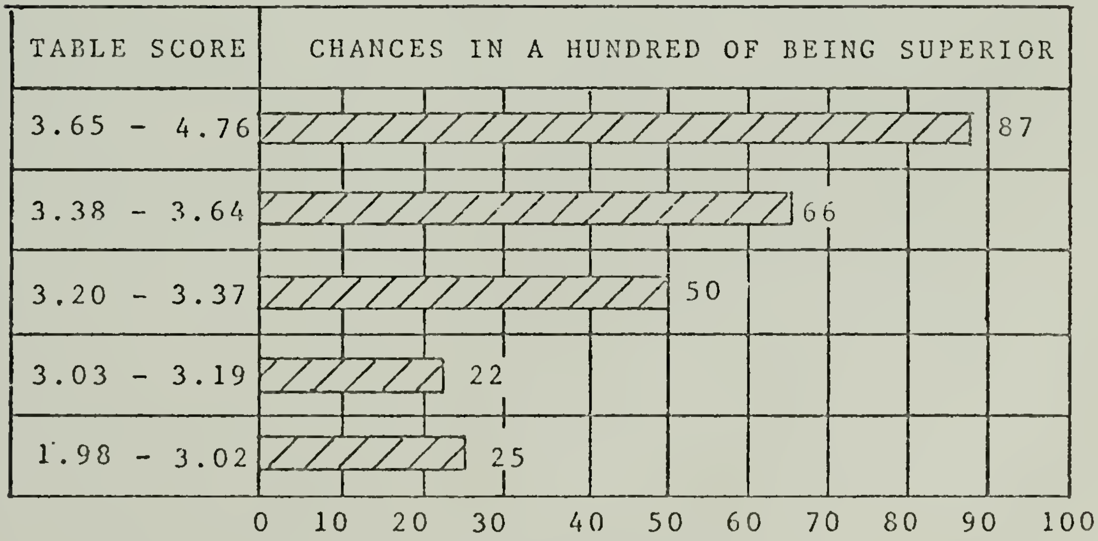


FIG. 2. EXPECTANCY CHART FOR INDIVIDUAL PREDICTION BASED ON THE RESULTS OF THE TABLES FOR PREDICTING QPR. THOSE RATED AVERAGE OR ABOVE AVERAGE WERE CONSIDERED SUPERIOR.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

The following are suggestions for further research:

1. Longitudinal study to discover predictors of effective performance of communications managers in operational billets.

2. Combining families of curricula to develop predictors of academic performance and satisfaction together.

3. Determination of Graduate Record Examination minimum scores for selection of applicants for graduate education.

4. Item analysis of the Strong Vocational Interest Blank to develop keys for predicting academic performance and satisfaction.

5. Use of larger samples to determine the predictive ability of all the variables examined in this study, including the biographical variables (especially the readily available and face-valid variables).

APPENDIX A

BIOGRAPHICAL QUESTIONNAIRE

	Biographical Questions	N = Yes	N = No
1.	Did you receive your commission from the USNA?	12	30
2.	Did you recieve your commission through an ROTC program?	13	29
3.	Have you ever been an enlisted man in any service?	13	29
4.	Is your rank Navy Lieutenant or below?	25	17
5.	Are you a pilot or other flight officer?	8	34
6.	Are you a submarine officer?	6	36
7.	Are you an unrestricted line officer?	37	5
8.	Are you a staff officer?	0	42
9.	Do you have a B.S. (not a B.A.) degree?	34	8
10.	Have you had at least one year of college calculus at an institution other than the Naval Postgraduate School?	26	16
11.	Do you speak at least one language other than English?	14	28
12.	Do you have a master's degree from a school other than the Naval Postgraduate School?	3	39
13.	Have you taken any graduate courses other than at the Naval Postgraduate School?	6	36
14.	Have you ever completed any courses at night school or through correspondence?	18	24

	Biographical Questions	N = Yes	N = No
15.	As an undergraduate in college, did you have an A or A- average?	2	40
16.	Was your undergraduate average in college below B-?	20	22
17.	Do you need to wear glasses for reading?	11	31
18.	Are you five feet nine inches or shorter?	12	30
19.	Are you 172 pounds or heavier?	29	13
20.	Are you white (Caucasian)?	42	0
21.	Are you black (Negro)?	0	42
22.	Was a branch of engineering your undergraduate major in college?	17	25
23.	Are you Roman Catholic?	10	32
24.	Are you Protestant?	28	14
25.	Have you ever been divorced?	1	41
26.	Are you married now?	39	3
27.	Do you have any sons?	21	21
28.	Do you have any daughters?	26	16
29.	Do you have any older brothers or sisters?	17	25
30.	Do you have any younger brothers or sisters?	24	18
31.	Is your father a college graduate?	13	29
32.	Has your mother ever attended college?	16	26
33.	Do you have a wife who is a college graduate?	18	24
34.	Is or was your father a career military officer?	5	37
35.	Is or was your father a career enlisted man?	3	39

Biographical Questions	N = Yes	N = No
36. Did you spend more than one year of your childhood on a farm?	6	36
37. Did you take a college-preparatory program in high school?	35	7
38. Were you in the uppor one-quarter of the college-preparatory program in high school?	26	16
39. Do you smoke cigarettes, cigars, or pipes?	20	22
40. Are you currently a student at any graduate school other than the Naval Postgraduate School?	0	42
41. Are you a student at the Naval Postgraduate School?	42	0
42. Would you say that you typically drink an alcholic beverage daily other than at mealtime?	8	34
43. Do you typically drink more than five cups of coffee a day?	11	31
44. Are you younger than 30 years of age?	16	26
45. Would you expect to use any skills learned in graduate school in subsequent assignments in the Navy?	41	1
46. Do you expect to use any graduate education obtained while on active duty in work after you retire from the Navy?	37	5
47. Do you wish to serve in a billet requiring the education that you would receive at a graduate school (P-coded billet)?	36	6
48. Would you prefer to do your graduate work at a school other than the Naval Postgraduate School?	16	26
49. Do you believe that postgraduate education will increase your chances for promotion?	35	7

Biographical Questions	N = Yes	N = No
50. Were you last designated a principal or an alternate (as opposed to neither) by the Postgraduate Selection Board?	29	13
51. Have you ever been a patrol leader or a senior patrol leader in the Boy Scouts?	18	24
52. Have you been a Star Scout or above in the Boy Scouts?	14	28
53. Have you ever taken lessons for a musical instrument for longer than two consecutive years?	17	25
54. Do you now play a musical instrument?	9	33
55. Are you satisfied with your education at the Naval Postgraduate School?	28	14
56. Are or were you in the curriculum of your first or second choice?	39	3
57. Were you ever in the baccalaureate program?	1	41
58. Have you ever spent time in the engineering science curriculum?	9	33
59. Do you now like your degree curriculum?	32	10
60. Would you choose a different degree curriculum if you could start over again?	9	33
61. Was at least part of your motivation to remain in the Navy the opportunity to receive postgraduate education?	20	22

APPENDIX B

GRADUATE EDUCATION POTENTIAL CATEGORIES FOR CLASSIFICATION

1. Capable of direct entry into a technical curriculum.

2. Capable of direct entry into a non-technical graduate program not requiring mathematical aptitude.

3. Potentially capable of entry into a technical curriculum after a refresher course of 3 - 6 months duration.

4. Capable of direct entry into a non-technical graduate program requiring some mathematical aptitude (would also meet category 5).

5. Capable of entry into an updating program which may lead to qualification for a technical curriculum after 6 - 12 months study.

6. Capable of qualifying for category 5 by taking off-duty courses.

7. No apparent potential for graduate education.

8. No accredited baccalaureate degree. Needs undergraduate program.

GRADUATE EDUCATION POTENTIAL CLASSIFICATION CRITERIA

1. Capable of direct entry into a technical curriculum.

    1) Possess an accredited baccalaureate degree with a minimum preparation of mathematics through the differential and integral calculus of several variables and a one year course in general physics using calculus as a tool. Marks achieved in all mathematics and physics courses be C or better and the overall average of these grades at least 2.50 on a scale having 2.00 as C.

    2) When academic credits include college chemistry or engineering credits taken in the junior or senior year, an overall average of 2.50 or better in all math, physics, chemistry and upper division engineering may be substituted for the required overall average in math and physics.

2. Capable of direct entry into a non-technical graduate program not requiring mathematical aptitude.

    1) Possess an accredited baccalaureate degree with an overall average of at least 2.75 on a scale having 2.00 as C.

    2) Have an academic major in a non-technical subject with an average of at least 3.00 in that subject. A general liberal arts degree with a 3.00 average may be used as a substitute if no major was pursued.

3. Potentially capable of entry into a technical curriculum after a refresher course of 3 - 6 months duration.

    1) Possess an accredited baccalaureate degree.

    2) Have passed mathematics courses through the differential and integral calculus of several variables and a one year course in general physics using calculus as a tool. Have at least a 2.00 average in all mathematics and physics courses.

    3) When courses of 2) have been taken, a GRE Quantitative Aptitude score of 550 or higher may be substituted for the 2.00 average.

4. Capable of direct entry into a non-technical graduate program requiring some mathematical aptitude.

    1) Possess an accredited baccalaureate degree with an overall average of at least 2.50 on a scale having 2.00 as a C average.

    2) Have completed successfully (C grades at least) a minimum of two college courses in mathematics at the level of college algebra or higher and have a Graduate Record Examination (GRE) Quantitative Aptitude score of 500 or higher.

    3) A GRE Quantitative Aptitude score of 550 or higher may be used in lieu of criteria 2).

5. Entry into an updating program which may lead to Qualification for a technical curriculum after 6 to 12 months of study.

    1) Possess an accredited baccalaureate degree.

    2) Have completed successfully (at least a C grade) at least one college mathematics course in algebra, trigonometry, or math analysis.

3) When no college mathematics has been taken, a baccalaureate degree with an overall average of 2.75, where 2.00 is a C average, or a GRE Quantitative Aptitude score of 550 may be substituted.

6. Could qualify for category 5 by taking off-duty courses.

   1) Possess an accredited baccalaureate degree.

   2) No evidence of mathematical inadequacy in form of low marks in courses attempted.

7. No apparent potential for graduate education.

   1) Possess an accredited baccalaureate degree.

   2) Not qualified in categories 1 - 5.

   3) Evidence of mathematical inadequacy by low marks in courses attempted.

8. No accredited baccalaureate degree.

APPENDIX C

STANDARDIZED QUALITY POINT RATIO

This appendix contains a statistical explanation and an example of analysis of variance, a graph, and tables of mean QPR's over time for the three sections of Communications Management students in the sample. The graph shows that there are some differences between the three sections and their mean QPR's; however, the analysis of variance (F statistic) of the mean QPR's shows that the differences were not significant differences. The standardized Z value of QPR was used in this study to eliminate as much of the random noise as possible.

ANALYSIS OF VARIANCE

Variance between means

$$SSb = \sum_{i=1}^{n} N_i(\bar{X}_i - \bar{\bar{X}})^2$$

Where $\bar{\bar{X}}$ = grand mean of total sample

$\bar{X}_i$ = mean QPR of sample i

Variance within means

$$SSw = \sum_{i=1}^{n} N_i \sigma_i^2$$

Where N_i = number of observations in sample i.

σ_i = SD of QPR in sample i.

F Statistic

$$MSb = \frac{SSb}{m-1}$$

Where m = number of groups

n = number in sample

$$MSw = \frac{SSw}{n-m}$$

$F = \frac{MSb}{MSw}$ An $F \geq 2.84$ would be significant at or above the .05 level for df 3 and 39.

EXAMPLE OF ANALYSIS OF VARIANCE

This is an analysis of variance of mean QPR's when data was collected for this study. Section HM 32 had completed five quarters, HM 34, three quarters, and HM 42, one quarter.

$$H_0 = \mu_5 = \mu_3 = \mu_1$$

$$SSb = 14(3.35-3.31)^2 + 16(3.36-3.31)^2 + 12(3.19-3.31)^2$$

$$SSb = .2352$$

$$MSb = .1176$$

$$SSw = 14(.28)^2 + 16(.23)^2 + 12(.41)^2$$

$$SSw = 3.9612$$

$$MSw = .1016$$

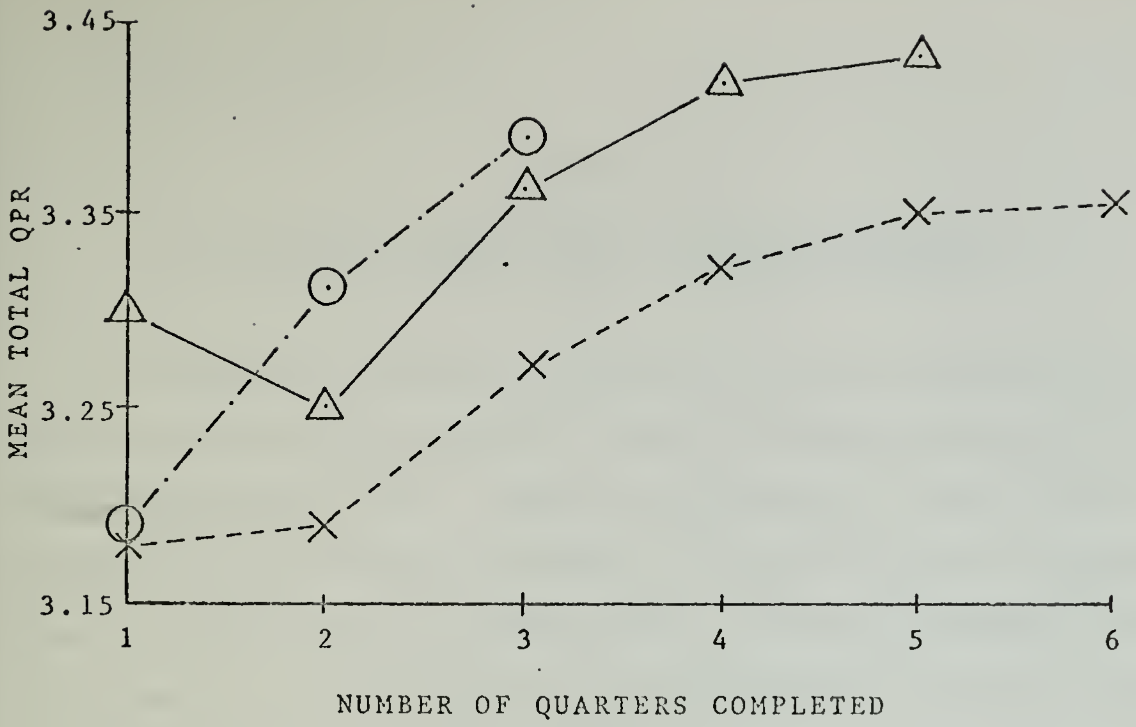
$F = \frac{.1176}{.1016} = 1.16$ which is not statistically significant.

The null hypothesis can not be rejected and the means could have come from the same population. In other words, the mean QPR's are not statistically different.

The standardized Z value of QPR was used to eliminate any variance which might be due to time in curriculum or the students within sections having different professors. Thus,

each person had a Z value of QPR computed based on his section's mean and standard deviation.

$$\text{QPRZ} = \frac{X_i - \bar{X}}{SD}$$



SECTION HM-32 SYMBOL = × N=14

QUARTERS COMPLETED	1	2	3	4	5	6
MEAN TOTAL QPR	3.18	3.19	3.27	3.32	3.35	3.36
STD.DEV. TOTAL QPR	.52	.40	.29	.26	.28	.22

SECTION HM-34 SYMBOL = △ N=16

QUARTERS COMPLETED	1	2	3	4	5
MEAN TOTAL QPR	3.30	3.25	3.36	3.42	3.43
STD.DEV. TOTAL QPR	.37	.38	.23	.25	.24

SECTION HM-42 SYMBOL = ⊙ N=12

QUARTERS COMPLETED	1	2	3
MEAN TOTAL QPR	3.19	3.31	3.38
STD.DEV. TOTAL QPR	.41	.35	.29

ANAYLSIS OF VARIANCE OF MEAN TOTAL QPR'S BY QUARTERS

QUARTERS	1	2	3	4	5
F STATISTIC	.348	.301	.609	1.079	.665

APPENDIX D

CORRELATION COEFFICIENTS FOR ALL VARIABLES WITH ACADEMIC PERFORMANCE AND SATISFACTION

This appendix contains a listing of all correlation coefficients for the two criteria: QPR and satisfaction for the sample group (N = 42). They are presented in order of biographical questionnaire questions, Strong Vocational Interest Blank, Graduate Record Examinations, and undergraduate academic performance. A correlation of 99.999 will be reported if no correlation was able to be computed.

BIOGRAPHICAL QUESTIONNAIRE QUESTION NUMBER	r WITH QPRZ	r WITH SATISFACTION
1	-.037	.090
2	.188	-.121
3	.168	-.204
4	.222	.242
5	-.175	-.028
6	.231	-.187
7	.079	-.215
8	99.999	99.999
9	.078	-.020
10	.228	.005
11	-.055	0.000
12	.090	-.016
13	.147	-.133
14	.064	.182

BIOGRAPHICAL QUESTIONNAIRE QUESTION NUMBER	r WITH QPRZ	r WITH SATISFACTION
15	.149	.167
16	-.162	-.054
17	.110	.009
18	-.216	.006
19	.216	.038
20	99.999	99.999
21	99.999	99.999
22	.283	-.008
23	-.010	-.077
24	.099	.244
25	.075	-.009
26	.034	.016
27	.038	-.019
28	-.268	-.073
29	-.134	-.359
30	.090	.166
31	.129	.003
32	.076	.191
33	.024	-.204
34	.197	.097
35	-.041	.133
36	-.198	.086
37	.389	.180
38	.133	.321
39	.210	-.016
40	99.999	99.999

BIORGRAPHICAL QUESTIONNAIRE QUESTION NUMBER	r WITH QPRZ	r WITH SATISFACTION
41	99.999	99.999
42	.128	.167
43	.164	-.121
44	.189	.112
45	.226	.386
46	.182	.198
47	.172	.626
48	-.025	.112
49	.167	.128
50	.127	.038
51	.078	.182
52	.046	.203
53	-.212	.108
54	.054	.343
55	.079	.691
56	.017	.388
57	.056	.116
58	-.070	.156
59	.063	.887
60	.086	.777
61	.140	.290

STRONG VOCATIONAL INTEREST BLANK

SVIB SCALE	r WITH QPRZ	r WITH SATISFACTION
Naval Officer	.319	-.096
Physical Therapist	-.252	.146
Dentist	-.132	.142
Osteopath	-.275	.023
Veterinarian	-.235	.081
Physician	-.121	.055
Psychiatrist	.047	-.116
Psychologist	.238	-.046
Biologist	.176	.103
Architect	.202	.150
Mathematician	.267	.088
Physicist	.274	.087
Chemist	.209	-.022
Engineer	.300	.148
Production Manager	.217	-.032
Army Officer	.062	-.151
Air Force Officer	.170	-.054
Carpenter	.065	.189
Forest Service	-.185	.032
Farmer	.043	.034
Math-Science Teacher	.063	.026
Printer	-.153	-.159
Policeman	-.243	-.018
Personnel Director	.154	-.193
Public Administrator	.177	-.128
Rehabilitation Counselor	-.010	-.050

SVIB SCALE	r WITH QPRZ	r WITH SATISFACTION
YMCA Secretary	-.333	-.030
Recreation Administrator	-.238	.018
Social Worker	-.151	-.164
Social Science Teacher	-.245	-.064
School Superintendent	-.005	-.003
Minister	-.212	-.037
Librarian	-.033	-.088
Artist	-.138	.010
Music Performer	-.340	.041
Music Teacher	-.101	.030
CPA Owner	.349	.058
Senior CPA	.398	.036
Accountant	.277	.033
Office Worker	.086	.005
Credit Manager	-.063	-.027
Chamber of Commerce	-.165	-.125
Business Education Teacher	-.126	.023
Purchasing Agent	.187	.087
Banker	.131	.052
Pharmacist	-.179	.116
Mortician	-.226	.062
Sales Manager	-.106	-.137
Real Estate Salesman	-.129	-.125
Life Insurance Salesman	-.231	-.066
Advertising Man	-.123	-.126
Attorney	.016	-.174
Author-Journalist	-.065	-.193

SVIB	r WITH QPRZ	r WITH SATISFACTION
President Mfg. Concern	.063	-.156
Computer Programmer	.427	.097
Interpreter	-.075	-.308
Doctor A-B	-.222	-.171
Academic Achievement	.166	.122
Liberal-Conservative	-.064	-.124
Masculinity-Femininity	.269	.076
Occupational Level	.171	.070
Extroversion-Introversion	.202	.135
Specialization Level	.142	-.084
NROTC Retention	.037	.054
Managerial Effectiveness	.245	-.218

GRADUATE RECORD EXAMINATION	r WITH QPRZ	r WITH SATISFACTION
Verbal	.130	-.364
Quantitative	.282	.021

UNDERGRADUATE ACADEMIC PERFORMANCE	r WITH QPRZ	r WITH SATISFACTION
First Year College GPA	.110	-.090
Second Year College GPA	.217	-.122
Third Year College GPA	.085	.028
Fourth Year College GPA	.441	.077
College Figure of Merit (FOM)	.230	.060

The correlation between academic performance (QPRZ) and satisfaction was .130 for N = 42.

APPENDIX E

GRADUATE RECORD EXAMINATION CUMULATIVE FREQUENCY DISTRIBUTIONS

This appendix contains cumulative frequency distributions, means, and standard deviations of scores received on the Graduate Record Examinations by the subjects in the sample.

The data is presented in the following order:

1. GRE Quantitative results.
2. GRE Verbal results.
3. GRE Verbal plus GRE Quantitative results.

The minimum score received on the GRE Quantitative test was 540 and that score was for two out of the 42 subjects; the mean score was 655. The Educational Potential Code criteria specifies in several categories that a GRE Quantitative score of 550 may be substituted for undergraduate mathematics courses.

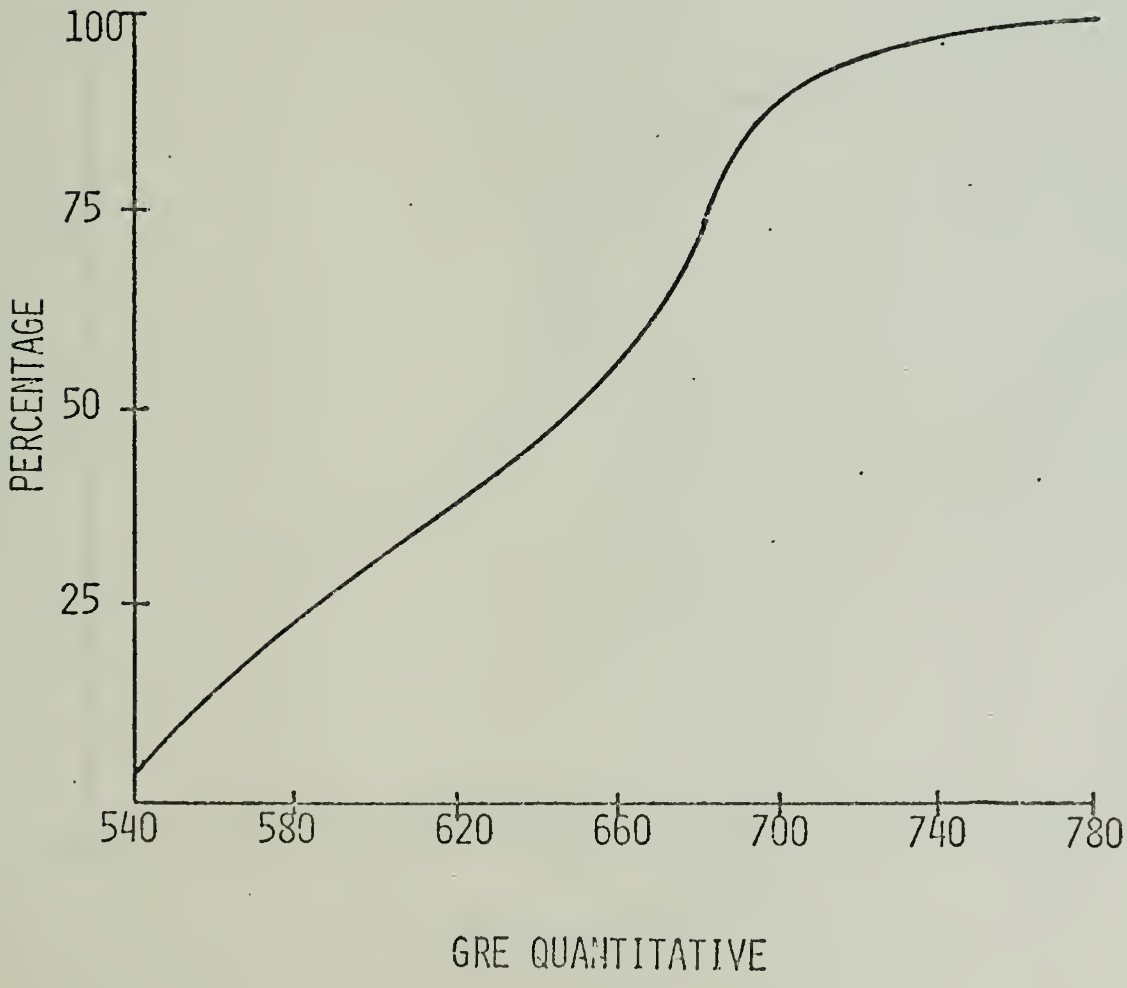
The subjects in the sample, for the most part, had been through a selection process and there has been a restriction of range in regards to academic aptitude. Even so, a cut-off score of 550 does not appear to be realistic. For this reason, further research is recommended to determine GRE minimum scores for selection criteria of applicants for graduate education.

CUMULATIVE FREQUENCY DISTRIBUTION (N=42)

GRE QUANTITATIVE

MEAN = 655

S.D. = 56

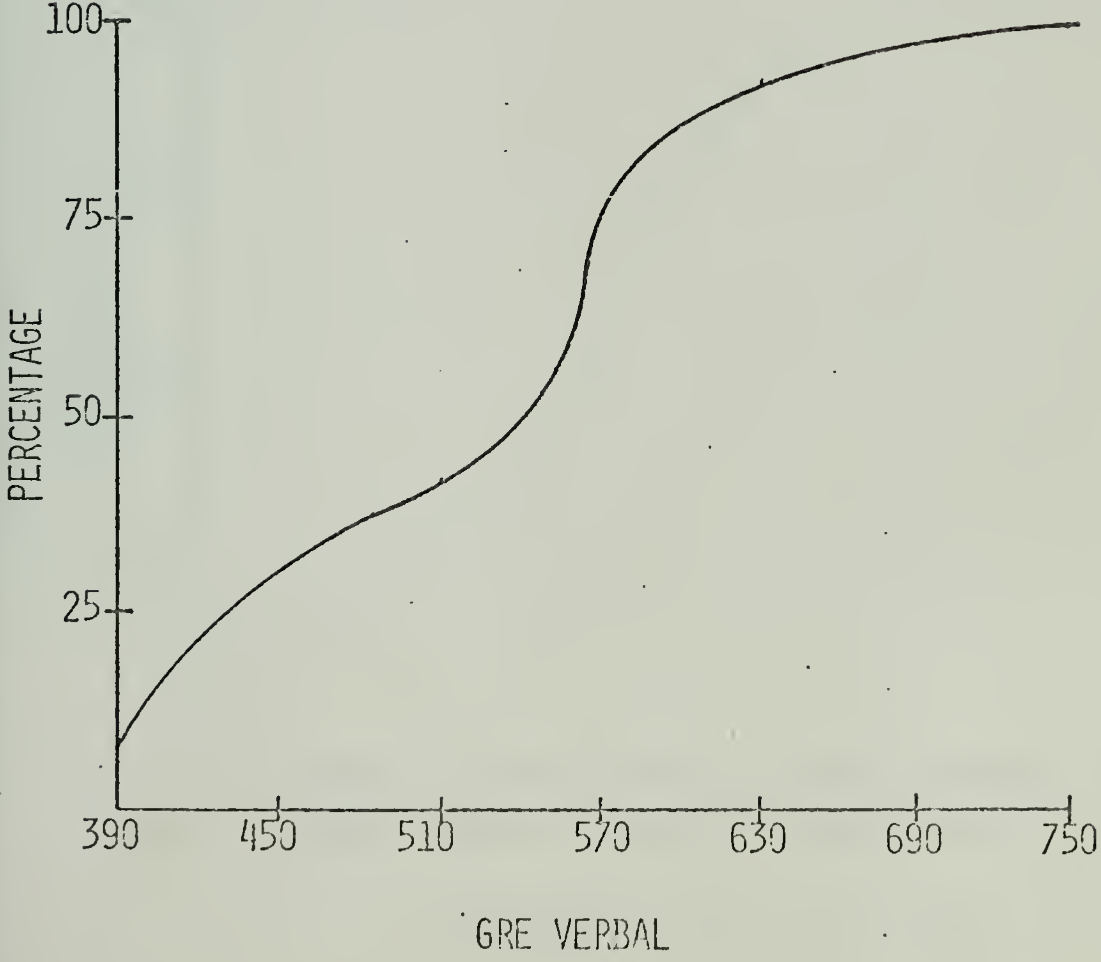


CUMULATIVE FREQUENCY DISTRIBUTION (N=42)

GRE VERBAL

MEAN = 543

S.D. = 88.3

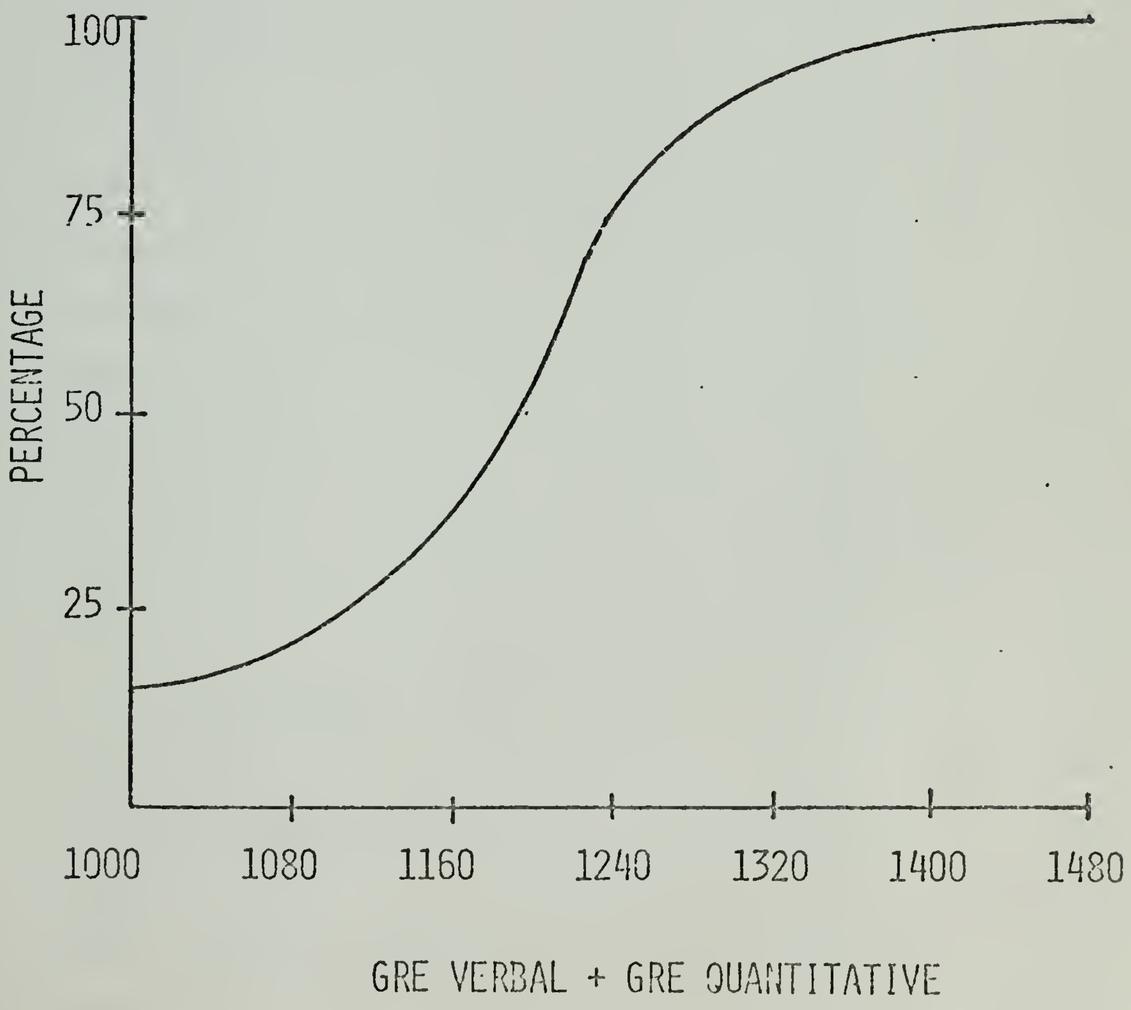


CUMULATIVE FREQUENCY DISTRIBUTION (N=42)

GRE VERBAL + GRE QUANTITATIVE

MEAN = 1198

S.D. = 114



APPENDIX F

STRONG VOCATIONAL INTEREST BLANK

SAMPLE PROFILE (N = 42)

Occupational/Non-Occupational Scale	Mean Std.Score	S.D.
1. Naval Officer	46.9	11.7
2. Physical Therapist	31.9	10.4
3. Dentist	27.0	9.8
4. Osteopath	27.0	9.7
5. Veterinarian	28.5	10.0
6. Physician	28.4	11.1
7. Psychiatrist	17.7	9.3
8. Psychologist	22.7	9.7
9. Biologist	24.9	13.4
10. Architect	29.4	10.5
11. Mathematician	20.9	11.8
12. Physicist	21.9	13.6
13. Chemist	29.6	13.2
14. Engineer	31.6	12.3
15. Production Manager	39.4	9.6
16. Army Officer	41.7	13.2
17. Air Force Officer	38.9	9.1
18. Carpenter	28.7	10.3
19. Forest Service	30.0	11.4
20. Farmer	36.1	8.4
21. Math-Science Teacher	28.5	7.7

Occupational/Non-Occupational Scale	Mean Std.Score	S.D.
22. Printer	30.4	9.7
23. Policeman	25.5	8.1
24. Personnel Director	27.1	11.4
25. Public Administrator	37.1	10.4
26. Rehabilitation Counselor	26.5	8.9
27. YMCA Secretary	24.6	11.9
28. Recreation Administrator	28.1	12.4
29. Social Worker	22.3	10.5
30. Social Science Teacher	25.9	11.1
31. School Superintendent	18.6	9.9
32. Minister	7.6	11.4
33. Librarian	24.3	9.7
34. Artist	25.4	8.9
35. Music Performer	26.1	9.5
36. Music Teacher	20.8	9.7
37. CPA Owner	27.1	11.5
38. Senior CPA	36.9	11.9
39. Accountant	30.5	11.7
40. Office Worker	30.4	10.2
41. Credit Manager	30.1	10.6
42. Chamber of Commerce	32.9	9.7
43. Business Education Teacher	29.7	10.5
44. Purchasing Agent	35.8	9.1
45. Banker	29.0	7.8
46. Pharmacist	25.7	10.2
47. Mortician	29.4	9.1

Occupational/Non-Occupational Scale	Mean Std. Score	S.D.
48. Sales Manager	27.5	9.7
49. Real Estate Salesman	34.7	9.1
50. Life Insurance Salesman	24.4	11.4
51. Advertising Man	27.2	8.5
52. Attorney	28.8	8.1
53. Author-Journalist	29.3	8.0
54. President Manufacturing Concern	23.9	9.3
55. Computer Programmer	36.6	12.6
56. Interpreter	24.3	10.1
57. A-B Doctor	39.0	10.6
58. Academic Achievement	44.7	9.3
59. Liberal-Conservative	42.1	9.3
60. Masculinity-Femininity	53.1	8.4
61. Occupational Level	58.3	7.1
62. Extroversion-Introversion	52.0	10.3
63. Specialization Level	38.7	9.7
64. NROTC Retention	54.8	9.2
65. Managerial Effectiveness	47.9	10.6

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